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The Mission of ES 401

The Environmental Studies Program at Middlebury College explores the relationship between humans and the environment. As a central component of this major, all students are required to take ES 401, a senior seminar designed to integrate interdisciplinary values of multiple foci with respect to a local issue. This combination is played out through service learning projects that examine a single environmental topic by identifying and working for community needs through an organized service activity so students gain further understanding of the human- environment relationship, a broader appreciation of the discipline of environmental studies, and an enhanced sense of civic responsibility.

The topic of the Fall 2003 semester was environmental justice. Working in correlation with the Toxics Action Center of Montpelier, VT, three service learning projects evolved to help decrease the disproportionately large ecological and economic burdens from corporate polluters and indifferent governmental agencies that are placed on working-class families of Vermont.

Environmental Justice

Environmental Justice is defined by David Naguib Pellow in *Garbage Wars: The Struggle For Environmental Justice In Chicago*, as "those social norms and values, rules, regulations, behaviors, policies, and decisions (that) support sustainable communities where people can interact with confidence that the environment is safe, nurturing, and productive" (Pellow 2002). However, this standard is difficult to achieve in an increasing number of communities around the country and around the globe. Industrial pollution combined with a "throw-away" society has resulted in escalating levels of dangerous toxic wastes that must be disposed of. The location of highly controversial toxic manufacturing and waste facilities is coming under scrutiny as researchers find glaring cases of discrimination and injustice around these sites.

Therefore, environmental injustice is defined by scholars as an act that:

> occurs whenever a person or persons…are impinged upon by an environmental burden for the alleged good of this society, that the rest of the society does not bear. An environmental injustice may impact a person of ANY race, class or income level as long as the environmental insult is through no fault of their own. (Robert, J. and Toffolon- Weiss, M. 2001).

This definition indicates that environmental injustices can occur anywhere and to any one.

The History of the Toxics Action Center – An Environmental Justice Organization

The first line of the Toxics Action Center's website states, "We all have the right to live in an environment free of toxic exposure. Our children should be able to grow up in communities where the air is safe to breathe and the water is clean to drink" (http://www.toxicsaction.org/about.htm). This statement exemplifies the principles of environmental justice and the universal desire for freedom from pollution that govern the Toxics Action Center. The Center helps neighborhood groups organize effective campaigns to make these goals reality.

The Toxics Action Center was founded in 1987 as an environmental non-profit designed to help Massachusetts residents combat toxic pollution in their neighborhoods. Since then, the Toxics Action Center has worked throughout New England with ten full-time staff members in Massachusetts, Connecticut, Maine and Vermont. Together, these offices have assisted more than 400 community groups in the fight against toxic pollution. (http://www.toxicsaction.org/about.htm). Projects have demanded the clean up of hazardous waste sites, stopped toxic pesticide application, halted unsafe mining, and prevented school construction on polluted sites (http://www.toxicsaction.org/issues.htm).

Across New England, people are outraged by toxic pollution from an unlimited number of sources including sludge, landfill construction, industrial emissions, and dirty power plants. Communities are saddened and wounded as children, adults, and animals are diagnosed with cancer and other serious maladies at alarming rates. Residents, friends and neighbors mobilize to stop these injustices, but rarely have a support network to ensure

success. They have never before been forced to launch a campaign against a corporation or the government.

The Toxics Action Center is an invaluable resource for these groups. Groups request assistance, and the Toxics Action Center responds in three ways: group training and assistance, a referral network, and by providing information. First, Toxics Action organizers offer seven consultations to guide leaders through developing a process to make community goals a reality (http://www.toxicsaction.org/grouptraining.htm). Second, the Toxics Action Center offers an expert referral network of lawyers and other professionals who have willingly and successfully worked on past environmental justice cases (http://www.toxicsaction.org/experts.htm). Lastly, the Toxics Action Center provides information ranging from toxics maps, to reports and guides about specific issues and organizing, to statewide conferences. On November 8, 2003 the Vermont Toxics Action Center held the first Vermont Toxics Action Conference in Randolph, VT. One hundred community organizers, including students and professors from ES 401, attended workshops and lectures, heard speeches from Congressman Bernie Sanders, State Auditor Elizabeth Ready, Love Canal activist and founder/ executive director of the Center for Health, Environment and Justice Lois Gibbs, networked with other activists, celebrated group success stories, and shared the pain of the effects of toxic pollution. Throughout these processes, the Toxics Action Center supports community groups, helping residents with community goals and developing organizational plans without overshadowing community campaigns with the goals of an outside organization.

The Role of Epidemiology in Environmental Justice

Any community or population claiming environmental injustice carries the burden of proof. To prove a case of environmental injustice, several conditions must be clearly established. For instance, it must be shown that the population in question is at an environmental disadvantage, which "the rest of society does not bear" (Roberts et. al, 2001). This generally requires testing and expertise in fields such as environmental chemistry or hydrogeology. Also, it must be shown that this unique environmental state has a deleterious

effect on the population in question, thereby necessitating remediation. Often these effects are public health related. In such cases, epidemiology can be used to show that an environmentally disadvantaged community suffers from a disease incidence statistically significantly different from the population at large. Expert analysis of health conditions in conjunction with family, behavioral and environmental risks, lends credibility to public health claims.

Cancer is a prevalent condition that is often feared to be associated with environmental hazards. An unusually high incidence of cancer reported in a population is known as a cancer cluster. According to Dr. Richard J. Jackson, the Director of the National Center for Environmental Health (NCEH), "cancer cluster reports are common because cancer is common." He reports that 85 to 95 percent of cancer cluster investigations result in insignificant findings. Of the 10 to 15 percent identified as true cancer clusters, he notes that a certain fraction is the result of the random distribution of cancer within the population (Jackson, 2001). These numbers show that without expert analysis by an epidemiologist it could be easy for companies or defendants charged with environmental injustice to argue that cancer cluster claims purportedly resulting from environmental contamination are unfounded.

Clarendon FIRST

Clarendon, VT residents Jackie Fenner and Wanda Crossman created Clarendon FIRST (Families Interested in Researching Sickness Together) in March 2003. Alarmed and saddened by the high occurrence of cancer in Clarendon's child population, and directly affected when Crossman's daughter was diagnosed with cancer, Fenner and Crossman resolved to identify the cause. In a town of 2,900 people, 3 children under the age of 18 have Acute Lymphocytic Leukemia (ALL), 1 child has Non-Hodgkin's Lymphoma, and many other children have learning and developmental disorders. Children are important indicators for the health of a community because they are normally a very healthy part of the population (Fenner, personal communication).

With the help of Alyssa Schuren from the Vermont Toxics Action Center, Clarendon FIRST formed and identified three goals for the group: 1) Document the health of Clarendon

residents, possibly identifying a cancer cluster, 2) Assess sources of environmental pollution in Clarendon, 3) Address this pollution through the necessary means, possibly including but not limited to compensation and medical assistance for the ill, clean up of contaminated sites, and relocation of the school. So far, Clarendon FIRST organizers have focused on health documentation, toxic threats, and identifying the sources of this pollution. Thorough health surveys created by Clarendon FIRST members, Toxics Action organizers and an epidemiologist at Boston University have been distributed to almost all of the 1,100 Clarendon households through extensive canvassing (Appendix 1). Fenner, Crossman, Janet Currie, and other Clarendon FIRST members have identified potential hot spots. These include a farm where Rutland sewage sludge was spread between 1986-1991, a General Electric aircraft engine factory turned Superfund site, the Rutland Airport, mining by US Samica, and blasting by mining company Cararra that has caused elevated gross alpha levels in groundwater forced neighbors to drink bottled water for 13 years.[1] Clarendon FIRST is now working with a variety of non-governmental and governmental groups including an environmental consultant, the Department of Health, the Agency of Natural Resources, VPIRG, and Middlebury College students. For more information, please see Clarendon FIRST's web page: http://www.anr.state.vt.us/dec/wastediv/sms/clarendon.htm.

Epidemiology in Clarendon

As a population, children are generally healthy. In most cases, they do not smoke or drink, they lead active lives and they have strong, young immune systems. Consequently, children serve as a public health indicator. An unusual number of children within the same small community all diagnosed with the same medical condition, are a cause for concern. When several children in the Clarendon school system were diagnosed with ALL, Jackie and Wanda had good reason to prompt an investigation into possible environmental contaminants in their community.

[1] Elevated gross alpha levels are due to elevated naturally occurring radioactivity in the bedrock in the Clarendon area. Blasting associated with mining can cause changes in groundwater flow patterns, bring water into greater contact with these bedrock formations.

Although children serve as indicators, a statistical epidemiological study is still critical to show that Clarendon has a cancer cluster. Through the expert referral network, the Toxics Action Center put Clarendon FIRST in touch with an epidemiologist from Boston University. In the case of a clear health problem, this expert will give them the credibility they need to approach the state and other agencies in search of an environmental cause and a solution. Clarendon FIRST's epidemiological endeavors began by going door-to-door conducting a community health survey. Extensive health questionnaires were delivered to every home in Clarendon. These surveys not only included a long list of personal and family health history questions (over a hundred for an adult male survey), but requests for additional information including past residencies, work environments, reproductive history, alcohol and tobacco use, and chemical exposure. Once surveys have been returned, each answer must be given a letter and number code and then entered into a database for the epidemiologist to analyze.

This has been a long, labor-intensive process for the Clarendon FIRST volunteers. They have tirelessly canvassed and spread the word about the importance of returning the surveys. Clarendon FIRST aims to have 1,500 completed surveys available for the epidemiologist in order to have a large enough sample size to facilitate accurate statistical analysis. Currently, approximately 400 surveys have been returned. However, they are determined to compile the necessary data. Organizers now hope to do a bulk mailing to deliver another round of surveys and bring in a new wave of data. If the epidemiologist confirms Clarendon FIRST's suspicion that their community is suffering from an abnormally high incidence of cancer, they can shift their focus to identifying the source.

ES 401's Role

Our ES 401 group assisted Clarendon FIRST in three ways: 1) canvassing Clarendon residents to document health issues and tease apart genetic and environmental factors, 2) coding and databasing health surveys for the epidemiologist, and 3) creating a GIS map so the effects of environmental hazards could be visualized and analyzed, and so information based on these observations can be used in future management, development, zoning, or legal decisions. Once all data from the health surveys is analyzed by an epidemiologist, our hope is

for future groups to add the health trends and socioeconomic data to our existing GIS map to draw correlation or causational conclusions about the relationship between hazardous waste sites in and surrounding Clarendon and rates of cancer or other health related issues of the community.

As part of the larger issue of environmental justice, our service learning project aims to provide the community of Clarendon with a useful tool to help combat the effects of pollution by supplementing scientific data, which can be used in lawsuits against corporate polluters and indifferent governmental agencies to close existing facilities and/or prevent building of future facilities, or by changing current policies concerning the discharge and disposal of hazardous wastes. Within the scope of the Environmental Studies major, our work with Clarendon F.I.R.S.T explores how the effects of humans on their environment (improper waste disposal) inherently affects the relationship between working-class families and their environment (health issues and injustices in Clarendon) using multiple values and skills from the fields of economics, political science, anthropology/sociology, biology, chemistry, geography, geology, literature, and history.

Canvassing: Narrative of a Day in Clarendon

ES 401 students spent two afternoons in Clarendon distributing health surveys (Appendix 1). After weeks of reading about environmental justice and communicating with Jackie and Wanda via email, canvassing reminded us of the values of interpersonal relationships and the strengths of community organizing. Going door to door meeting Clarendon families helped us understand the importance of Clarendon FIRST and the community we were working in. The following narrative describes the experience one student had.

As the screen door slammed behind me, I saw that they were ready for us. Piles of surveys spilled over the diner tables and toppled out of the boxes that littered the floor. Florescent tee shirts reading Clarendon FIRST were tacked to the walls over the coffee machine and counter. The warmth of the front room of the Whistle-Stop Cafe bustled with determination. Jackie and Wanda handed us our nametags, which we hung around our necks

like soldiers donning armor for battle. Heads together, elbows pushing spoons and napkins to the edge of the tabletop, we poured over a road map of Clarendon. The roads marked in red had already been canvassed and our job was to stop at every house on the remaining roads and hand out surveys. After memorizing directions to our section of town, arming ourselves with heavy stacks of surveys, and piling into cars, our convoy sped out of the driveway, waving as we went.

The next several hours were filled with squeaking screen doors, wrong turns, barking dogs, u-turns in driveways, squinting at mailbox numbers, brave smiles, thank you's, tires spinning in mud, dirt roads disappearing into the woods, welcoming, thankful, friendly folk, unanswered doorbells, dead ends, lazy cats in windows, blue knuckles rapping on tall wooden doors, smells of dinners, wild Halloween lawn ornaments, small children peering out between mothers' legs, and cozy houses filled with knickknacks. As the sun set, our stack of surveyed diminished, and our stomachs began to rumble, we realized just how well people surprised us. The citizens of Clarendon were overwhelmingly glad to see us working for the health of their town. We had visited ever house and given away every survey. The people we had met cared about their community and their families and were willing to open their doors and homes to us and fill out pages and pages of personal information to improve the health of Clarendon. We were never met with a no, and as we filed into the warm Whistle-Stop, warming up our hands and piling our boxes on the floor, we knew that we entered a long process of hard work, but that we had given it a good start.

Coding and Database Development

After Clarendon residents complete the health questionnaires and before the data can be passed on to the epidemiologist, each survey needs to be coded and databased. Our ES 401 group received approximately 200 surveys from the Toxics Action Center to be coded. These 200 completed surveys were from initial round of spring 2003 canvassing. Because the surveys contained private information, each student coder had to sign a document agreeing to keep the information confidential. For each survey, every question was assigned a section letter, a question number, and a number or letter dependent on the answer. For example,

question number 3 in section C (the Personal Health section) would be labeled IC31 for yes and IC32 for no. This was the most time intensive part of our project. We originally held two "pizza and coding parties," at which almost all our classmates helped us code. But, we coded fewer than 100 surveys at these parties. Therefore, five members of our group used the remaining lab periods and outside work time to complete the coding. Once finished, the codes had to be entered into a database for the epidemiologist.

Through coding and databasing we learned about the hard work necessary to run a grassroots environmental justice campaign. Community organizing requires dedication, persistence, and the willingness to engage in day-to-day work. Even after hours of coding we only completed 200 surveys, barely 13% of the total the epidemiologist needs. This increased our admiration of Jackie and Wanda. They dedicate their time and energy to finding and eliminating the cause of illness in their community because they do not want anyone else to get sick. They do this while running their own businesses. Neither has been deterred by work like coding or sifting through state government files on toxic spills. The coding component of our project exemplified the hard, sometimes tedious, labor that is central to the success of environmental justice groups.

Physical Geography Mapping

In an attempt to put both theoretical and analytical spins on our work with Clarendon FIRST, we chose to make several maps to analyze the physical geography of Clarendon. Our primary motivation was to provide Clarendon residents with a better geographical and topographical understanding of their surrounding environment. However, a main focus of our GIS mapping and analysis dealt with soil drainage capabilities. Members of Clarendon FIRST suspected that drinking water might be one of the main ways in which toxics move through the environment, make their way into peoples' bodies and cause illness in the town. As a result, we looked at different factors that affect water movement. Because soil characteristics can directly affect the movement and quality of both ground and surface water,[2] we attempted to correlate the area slope and soil characteristics to inspire future

[2] Surface water includes streams, creeks, rivers, lakes, and ponds.

research on the hydrology of Clarendon. Our final goal for the mapping section was to create a template to be used by future groups to incorporate new data as it becomes available. This will enable Clarendon FIRST to successfully build a case for toxic contamination of geological systems and how they may or may not affect human health.

Geologic Setting

Clarendon is situated between the Green and Taconic Mountains in the Vermont Valley. This region was shaped and/or significantly altered by glaciation. The glacial retreat deposited sediment, forming uplands comprised mostly of till and lowland valleys of outwash sand and gravel and loamy alluvial deposits from glacial meltwater (Ferguson, 1998).

The sand and gravel that dominates the soil substrate in the Clarendon area allows an unconfined aquifer to exists relatively close to the land surface, as is the case with much of Vermont that shares similar soil characteristics. This proves beneficial for well owners, who are not forced to dig deep or break through a confining layer, but becomes problematic when concerned with possible toxic contamination. According to a "Ground-water Favorability Map of the Otter Creek Basin, Vermont" published by the Vermont Department of Water Resources in 1967, the area surrounding Cold Creek, a branch of Otter Creek in Clarendon, is ideal for well-drilling in order to access groundwater since the area is underlain by thick glacial deposits. This implies that the water table is relatively shallow, especially in the riparian zones surrounding the creek. However, the discussion of the Rutland County aquifer is mostly speculative since no recent hydrological data detailing location and other characteristic features of groundwater storage areas exists.

Soil composition plays an important role in determining how quickly water moves through the environment and whether precipitation will remain as surface run off or whether it will seep into the groundwater. Water flow through sediments depends on permeability, which is defined as the hydraulic conductivity or the rate of water flow through substrate. Permeability rates of water for different soil types are as follows: 100's mm to 100's cm/hr for gravel dominated; 12-25 mm/hr for sandy soils; 2-12 mm/hr for loamy soils (mix of sand, silt, and clay); and 0.2-2 mm/hr for clay soils. Three-quarters of all precipitation infiltrates the soil where it is then subject to redistribution. The other quarter directly feeds into open bodies of water and evaporates (Peter Ryan, personal communication). Water follows many

different paths including evaporation, uptake by root systems, transpiration, capillary rise within the soil, flow of water between soil or rock layers to surface water, or groundwater recharge. Groundwater recharge is typically from infiltration of either rain or surface water, which passes through soil and cracks in bedrock in the unsaturated zone to the underlying aquifer (Figure 1). Depending on water table and riverbed elevations, aquifers can either supply streams, rivers, and lakes with additional water, or be supplied with water from these surface waters (Figure 2).

The GIS analysis and an understanding of water movement through soil indicate a clear relationship between surface and groundwater. Lacking any conclusive geological data, determining whether the creek recharges groundwater or vice versa could not be established. But, it can be assumed that pollution in one will eventually affect the other. The movement of water between groundwater and surface water (including soil water – water in the top few inches of soil often due to flooding or rain) provides a major conduit for chemical transfer including the transfer of toxic pollutants (Winter et al., 1995). Soluble contaminants dissolved in water reach either groundwater or surface water directly. In contrast, insoluble contaminants are delivered to surface water by erosion and transport during overland flow in times of high water or flood-like events where water does not infiltrate the ground,[3] thus entering the water system by a more indirect route. The type of materials present on the land surface and the length of time that water is in contact with those materials control water chemistry. When determining possible pollution, questions about whether enough time exists for chemicals on the surface to become dissolved or react with water and then move either overland to surface water or infiltrate groundwater must be raised. Water contamination is due mainly to the adsorption of minerals to water molecules, which then travel through soils to recharge groundwater sources.

Assumptions in the Analysis

While conducting this analysis it was necessary to make assumptions regarding the geology of the area because some data were unavailable and we were unable to conduct a more detailed survey ourselves. Our analysis assumes that the aquifer beneath Clarendon is shallow

[3]Infiltration directly into the soil may not occur for a number of reasons including previous extreme dry conditions that impede soil saturation, supersaturation of the soil, or unexpected "flashy" conditions that inundate an area within a short period of time.

and unconfined as the result of glacial deposits on top of the bedrock. The implications of a shallow, unconfined aquifer are that recharge of the aquifer will be rapid and that the recharge water will originate from local sources. It is also important to mention the aspects of water movement which we did not include. We did not examine the underlying hydrology of the area. This information would have given us a better picture on the direction water moves through Clarendon and also how quickly water might take to move below the surface, independent of surface slope from one location to another. This information was not included because at this point good hydrological data for the Clarendon area does not exist.

Map Creation

The series of GIS maps we created document a geographical exploration of Clarendon's physical environment and the potential for toxic contamination of the town's water. Our project includes elevation, percent slope, potential soil seepage, potential groundwater contamination, and potential surface water contamination maps.

The elevation map shows that Clarendon occupies a topographic low area. It is surrounded by higher elevations to the east and west, while Route 7 and Cold Creek run north south (Figure 3).

Because the movement of surface water and infiltration depend on slope, slope in Clarendon was analyzed to create the potential contamination maps (Figure 4).

To make the seepage potential map, the permeability of the soils was assessed based on soil composition. Soils with a majority of clays and silts prevent water from soaking into the surface and result in higher amounts of surface runoff. Soils with higher amounts of sand and gravel allow water to run through these larger materials and into the groundwater. Soil data were taken from the State Geologic Survey and each soil type was reclassified into four categories based on its permeability (Figure 5).

To obtain the potential groundwater contamination map, areas with both low slope and high seepage values were highlighted and given a new value representing a high potential for groundwater contamination. Areas with a low slope will allow water to remain on the surface for longer making it easier for the water to soak into the soil and become part of the groundwater system. Areas with high seepage values (sand and gravel soils) will allow water to quickly move through the soil and enter the groundwater. When these two slope and

seepage attributes share the same location the potential for groundwater contamination is increased (Figure 6).

To obtain the potential surface water contamination map, areas with both high slope and low seepage values were highlighted and given a new value representing a high potential for surface water contamination. Areas with a high slope will cause water to quickly run off the surface and move down slope into larger bodies of water such as lakes and rivers. Areas with low seepage values (silt and clay soils) will prevent water from moving into the ground and instead cause it to run off the land and into surrounding waterways. When these two slope and seepage attributes share the same location the potential for surface water contamination is increased (Figure 7).

Implications and Limitations of the Analysis

The results of this analysis indicate that there is a significantly higher potential for groundwater contamination than surface water contamination in Clarendon. While nearly no areas were identified as having a very high potential and only a few as having a high potential for surface water contamination, the northeastern corner of Clarendon was identified as being almost entirely comprised of soils with either a very high or high potential for groundwater contamination.

While the simplicity of the analysis and the lack of more detailed hydrological data prevent any definite conclusions from being drawn, the analysis and subsequent maps present a preliminary exploration and understanding of how soil slope and type affect water movement in Clarendon. The maps indicate it is more likely water will become part of the ground water system than the surface water system, and that the northeast corner of Clarendon may be a groundwater recharge zone, therefore contributing water and any associated toxins to the groundwater.

Suggestions for Further Research and Mapping of Clarendon

This analysis provides a springboard for further research. By examining the maps and ways in which they were generated, one can pinpoint areas for further investigation without wasting valuable time and resources examining aspects of the system, which may not significantly affect Clarendon and how people are becoming ill. Given the many areas with a very high potential for groundwater contamination, we suggest that energy be focused on testing wells in the

town and on generating a detailed map of how groundwater moves through the underlying sediment and bedrock, where its sources are, and how it is regenerated. This will make it possible to more precisely locate those areas that would be most likely to cause contamination of Clarendon's water if toxics are located on or nearby them. Lastly, it is important to remember that the analysis was conducted with the ultimate goal of finding out what may be causing a deterioration of health in Clarendon and how the present situation can be remedied. While this analysis provides an insightful and powerful way to view the landscape and the movement of water and toxics, the human dimension to this problem must always remain at the forefront as one poses and answers question regarding the situation.

Building a Case for Clarendon as Environmental Injustice: A Socio-Economic Perspective

Our work this semester attempted to define the situation in Clarendon as an environmental injustice. Compounding factors such as unavailable epidemiological data, incomplete toxic information, and an unfinished environmental analysis combined to complicate this goal. Many of these efforts are contingent upon receipt of funding or volunteered effort from numerous people. Our interaction with Clarendon FIRST has certainly educated us on the complications of grassroots organizing and the dedication it takes to keep people energized and active.

This reality was a great frustration. We decided to explore other variables that could give us an idea if environmental injustice was a legitimate concern for Clarendon. To do this we examined U.S. Census Bureau data for Rutland County and were able to draw some interesting conclusions.

Socio-Economic Background

Clarendon is a rural suburb of the City of Rutland, which is located just a few miles north along Route 7. This community of approximately 3,000 people is nestled along the Cold River, a tributary that empties into Otter Creek, which runs north to Lake Champlain (Guertin, 2000). The town consists of two main sections divided by Route 7, with the post office and schools to the west, and an airport, landfill, and local restaurant called The Whistle

Stop to the east. The community is sparsely distributed with approximately 1,100 households scattered over the area (Fenner, 2003).

Toxic Distribution

Clarendon is within close proximity to farms, a General Electric plant, Cararra and U.S. Samica mining facilities, the Rutland airport, and a landfill that services the surrounding area. For a community of only 3,000 people, it seems that many highly polluting industries and services have been located in its midst, causing Clarendon to bear the burden of wastes for the entire region.

The Toxic Releases Inventory, which is maintained by the U.S. EPA, provides data on all reported toxics from industries throughout the country. Looking at the data for Rutland County as a whole provides an interesting view of the dispersal of toxics. Both General Electric and U.S. Samica Inc. are on Windcrest Road, a road that runs along the northeastern corner of Clarendon and into Rutland Town. These two industries emitted 12,536 and 8,200 pounds of toxic chemicals respectively during 2001 for a total of 20,736 pounds of emissions. Amongst the chemicals emitted were chromium, lead compounds, hydrogen fluoride, and methyl ethyl ketone. To put this in perspective, Rutland County as a whole emitted 37,194 pounds of toxic substances that year. (U.S. EPA, 2003). Thus, in 2001 over half of all the reported toxic emissions in Rutland County occurred on one road in the northeastern corner of Clarendon.

GIS Analysis

First, Figure 8 demonstrates that Clarendon is doing relatively well in terms of poverty (US Census Bureau, 2003). The figure indicates that only 7.3-9.2 percent of Clarendon residents live below the poverty line. Towns to the west, with less access via major roads to Rutland, have higher poverty rates, and towns to the east, with access to Rutland via routes 4 and 103, have lower poverty rates. These data suggest that Clarendon's proximity to Rutland and its location along a major travel route have made it an attractive location for less desirable, polluting industries and services.

Figure 9 shows Clarendon's overall population level in relation to the surrounding towns (US Census Bureau, 2003). As seen in this figure, Clarendon's population is similar to

those towns to the north of Rutland along Route 7, indicating no specific reason for Clarendon to be chosen for industry over those towns. One hypothesis that can be presented is that the prevailing winds in the Northeast tend to come from the west and north, resulting in the city of Rutland being downwind if more polluting sources were located to the north.

The town of Clarendon is shown in Figure 10 to have a median age of 41.3-42.6 (US Census Bureau, 2003). This is fairly consistent with the towns to the east, while the towns to the west are primarily younger. The median age is an indicator of a more settled community of older people with families, or people who have been settled there for a longer period of time.

Figures 11 and 12 examine Clarendon's population more closely by looking at the percent of rental housing and the percent of homes that are mobile homes (US Census Bureau, 2003). Figure 11 shows that Clarendon is in the second lowest category of percent of rental units, with only 15.6 to 19.4%. This indicates Clarendon is primarily inhabitant-owned housing, insinuating a stable and permanent community. Figure 12, however, shows a very interesting trend. Clarendon has the highest number of mobile homes, 23.1-48.7% of residencies, in the entire region. This number indicates that although many people in Clarendon have a vested, owner interest in their housing, the overall value of those houses that can be afforded is low for the region with approximately a quarter to a half of homes being mobile homes.

Considering mobile homes as an indicator of lower income, it is interesting then to compare those findings to the results shown in Figure 13. This figure shows the percent of the population with at least a high school diploma, and Clarendon ranks well regionally with 82.9-87.5% of the population over age 25 falling into that category (US Census Bureau, 2003). It is interesting to note that this figure also shows the suburbs to the east of Rutland to have higher education rates overall, while among those to the west only two towns are higher with the rest being more comparable to Clarendon.

Figures 14-17 delve into the percentages of people employed in manufacturing, farming/fishing/forestry, construction/extraction/maintenance, and management/professional/and related categories respectively (US Census Bureau, 2003). Figure 14 shows that 14.4-19.0% of Clarendon residents are employed in manufacturing, which is proportion higher then in the Rutland area and suburbs to the east, but comparable to

towns to the south and west. Figure 15 demonstrates that Clarendon has 0.0-1.5% of its population employed in the farming/fishing/forestry category which seems to be consistent with towns surrounding Rutland, but is lower than towns to the south. In Figure 16, it can be seen that Clarendon has 12.4-16.2% of its population involved in construction/extraction/maintenance categories, which is consistent with towns to the west and south of Rutland, but is higher then the towns to the east. Finally, Figure 17 shows that Clarendon has 0.0-24.1% of its population employed in management/professional/and related positions while that percentage is consistently in the 47.9-67.6% range to the east of Rutland.

Lastly, Figure 18 displays telling data about the percentage of the population that earns $100,000.00 a year or more (US Census Bureau, 2003). Clarendon has only 6.1-9.9% of its households in that range, while towns to the east of Rutland are consistently higher and towns to the west are similar to Clarendon or lower.

These statistics paint an interesting picture of Clarendon as a part of the Rutland region. It is clear that Clarendon is home to more blue collar workers then the towns to the east of Rutland where it seems professionals and people in management positions have located. Clarendon also has higher poverty rates, more mobile homes, lower education percentages, fewer households with high earnings, and a relatively smaller population than towns to the east. Towns to the east of Rutland, with major transportation routes like Route 7, are convincingly wealthier than Clarendon and towns to the west. When looking at all these factors together, it seems there is some discrimination occurring in the placement of these polluting facilities.

Limitations

This analysis however, is unable to discuss other factors that may impact siting of these facilities. Perhaps Clarendon has the perfect soils for an airport or a landfill. Perhaps Route 7 was preferred to Route 4 for reasons unknown. Perhaps there was an effort to concentrate more polluting industries in Clarendon to minimize human impact before Clarendon's population became established. However, if this is the case, it again seems unjust that lower income people would be forced to live near polluting industries simply because that is where land was inexpensive. Perhaps similar towns to the west of Rutland were not considered because they lacked clear transportation routes, or because they had more

farming. In order to solidify the conclusions supplied through this analysis, further research would have to be done including an analysis of toxic sites in other towns in the region.

Making a Case for Environmental Injustice

Although many of these relationships are simply assumptions, when considered as a whole the data demonstrate a trend towards locating dangerous wastes in a community that is of a lower socio-economic status. The implications of these actions have provided a basis for suspicion about the health complications in the Clarendon community, resulting in an awakening of the region as a whole to the challenges of environmental justice.

With the addition of socio-economic data such as those presented above, it is clear that there is the possibility for an environmental injustice in Clarendon. However, we cannot confirm this finding until some of the additional theories mentioned above are worked out. Thus, we find ourselves with another weapon but still no clear enemy. The questions now become how much of an arsenal needs to be built before Clarendon FIRST can attack the problem? Is formal designation as environmental injustice important?

Ongoing Work for Clarendon FIRST

Our work is just a small part of the ongoing work of Clarendon FIRST. From here, Jackie and Wanda will continue to work with officials at the state level to raise awareness about the health concerns and attempt to trace the sources. They will continue further GIS analysis, keep distributing and collecting health questionnaires, and continue to look through records documenting toxic spills in Clarendon. They will compile the scientific evidence from the environmental consultant and epidemiologist to identify and strengthen their case. Once information from all these sources has been collected, Clarendon FIRST will decide whether to take legal action for clean-up of their community, or whether they must look for other sources of the illnesses.

Conclusion

In our first meeting with Jackie and Wanda in September, Jackie concluded our meeting by saying, “I don’t want to move, I just want to fix it (Fenner 2003).” This comment epitomizes the reactions of similar community actors from around the country that we have read about throughout the semester. Although we were unable to define whether or not this is truly a case of environmental injustice, that formality seems almost irrelevant. Injustice or not, this community has developed an environmental and societal consciousness that has empowered them to take control of their surroundings and to have confidence in their own action to continue to press forward.

As you can see from Jackie’s comment, they certainly will not be going away.

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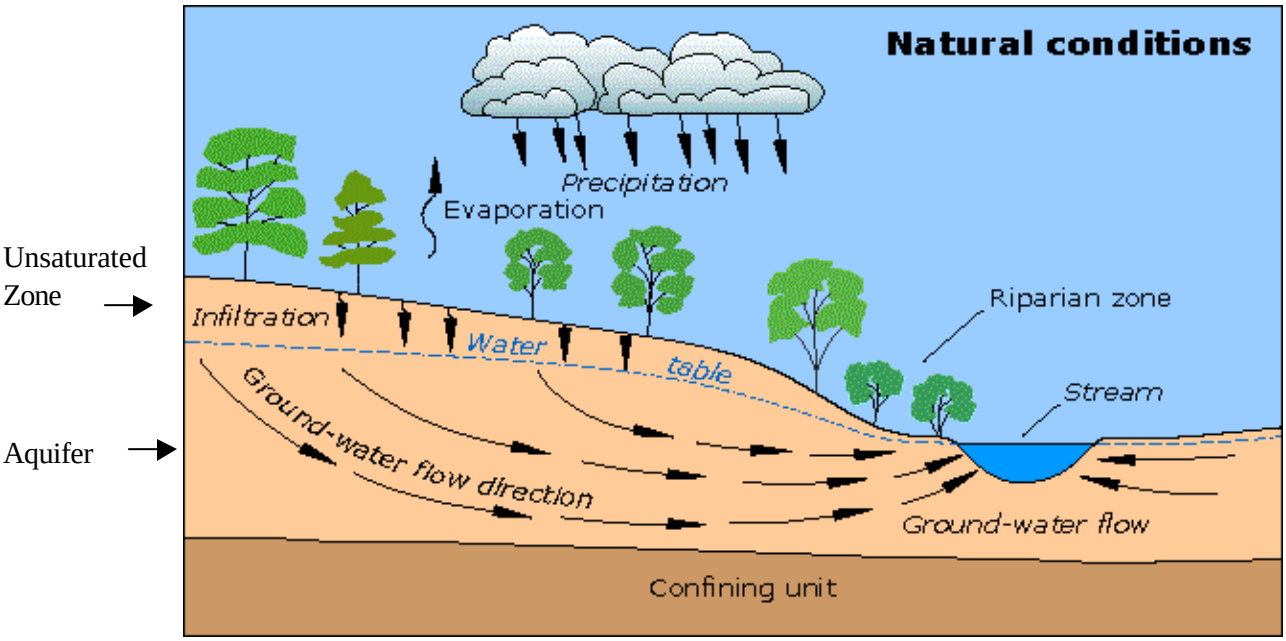
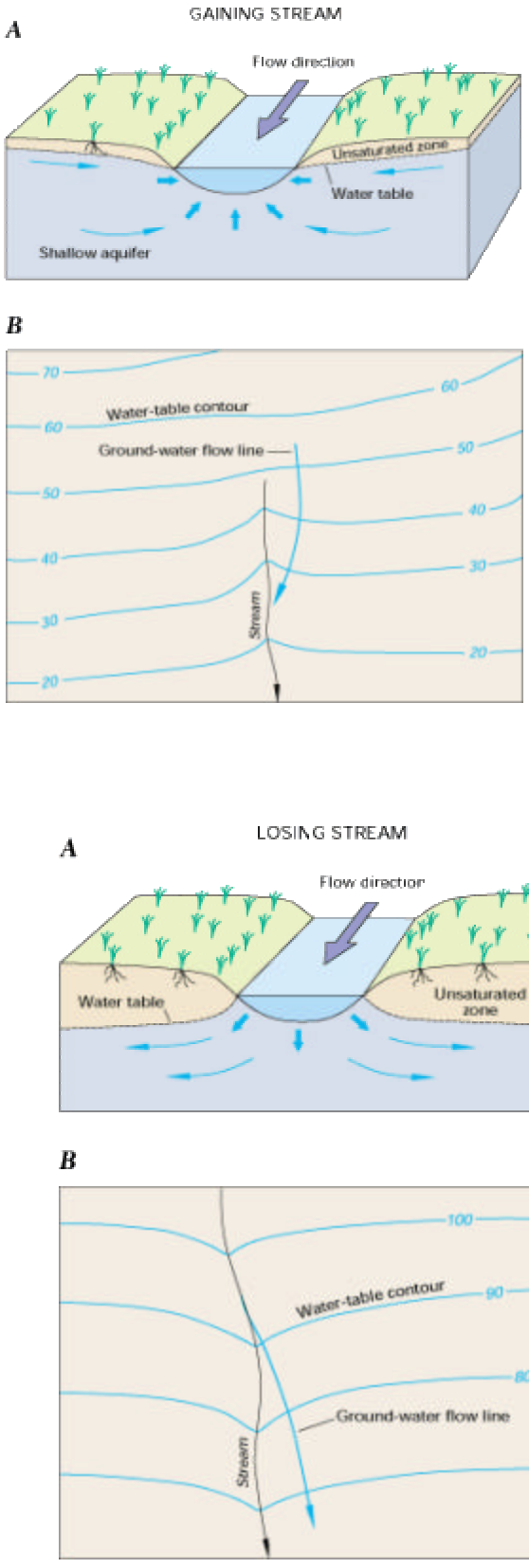
Figure 1: Groundwater Recharge Diagram



http://ga.water.usgs.gov/edu/earthgwdecline.html

Figure 2: Interaction Between Groundwater and Surface Water



Gaining streams receive water from the groundwater system (A). This can be determined from water-table contour maps because the contour lines point in the upstream direction where they cross the stream (B).

Losing streams lose water to the ground-water system (A). This can be determined from water-table contour maps because the contour lines point in the downstream direction where they cross the stream (B).

Source: "Ground Water and Surface Water A Single Resource," USGS Circular 1139, 1995.

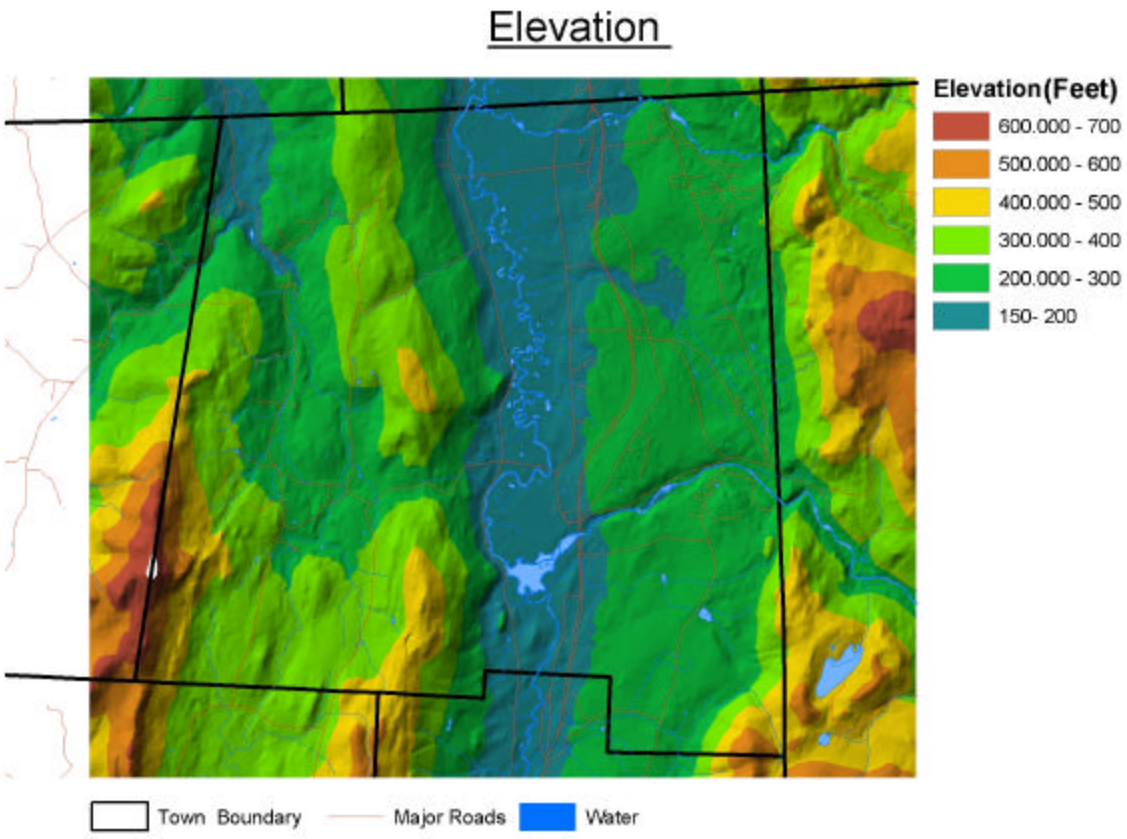


Figure 3: The Elevation map shows how the town of Clarendon occupies a topographic low area in the landscape, essentially sitting in a bowl and is surrounded by higher areas to the east and west while Rt. 7 and Cold Creek run north to south. Clarendon's lower elevation relative to the surrounding landscape is especially important to consider. This shape will cause rainwater to move down slope and into the town, potentially concentrating any toxics that water might contain or pickup in this area.

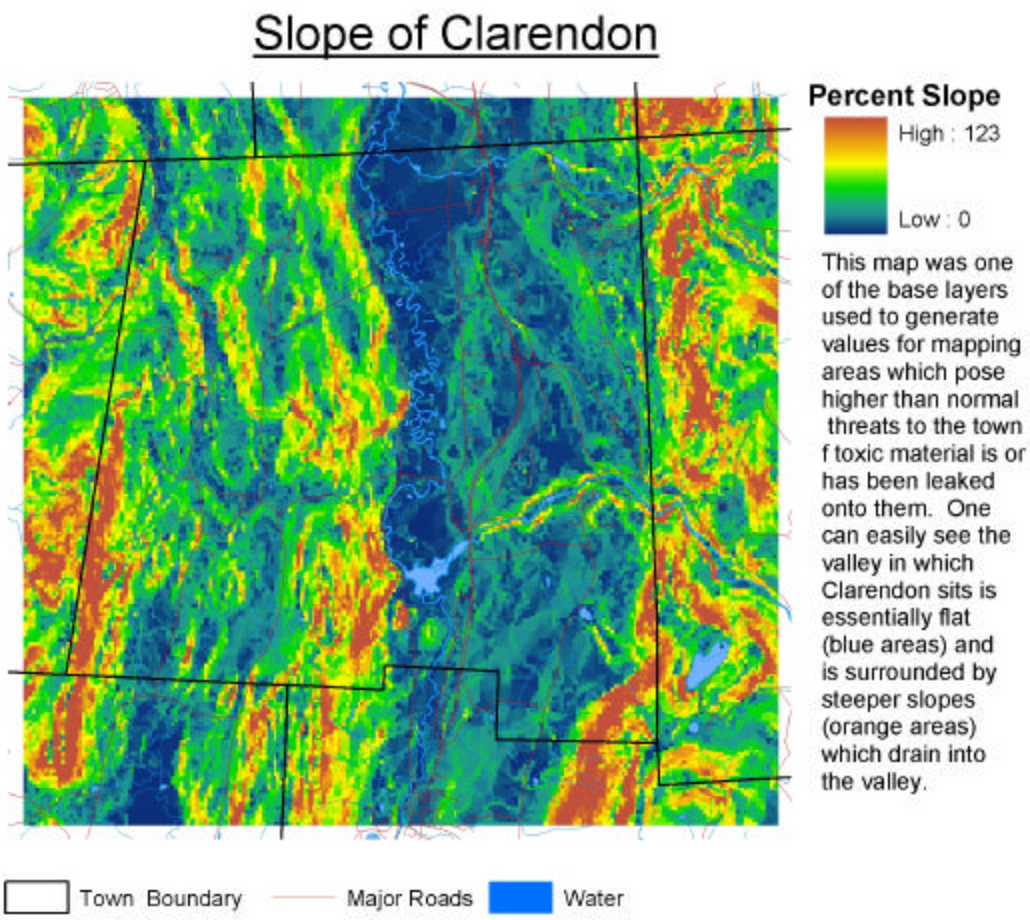


Figure 4: Landscape slope map. The two aspects of soil that play the largest role in determining how quickly water moves through the environment and whether water which falls on the surface will remain aboveground and run off into rivers as surface water, or whether it will seep into the groundwater and from there move into the water table are the slope of the landscape and soil permeability. These two variables were mapped (Figures 4 and 5) and then the two maps were overlaid on top of one another to produce the maps showing potential surface and groundwater contamination (Figures 6 and 7).

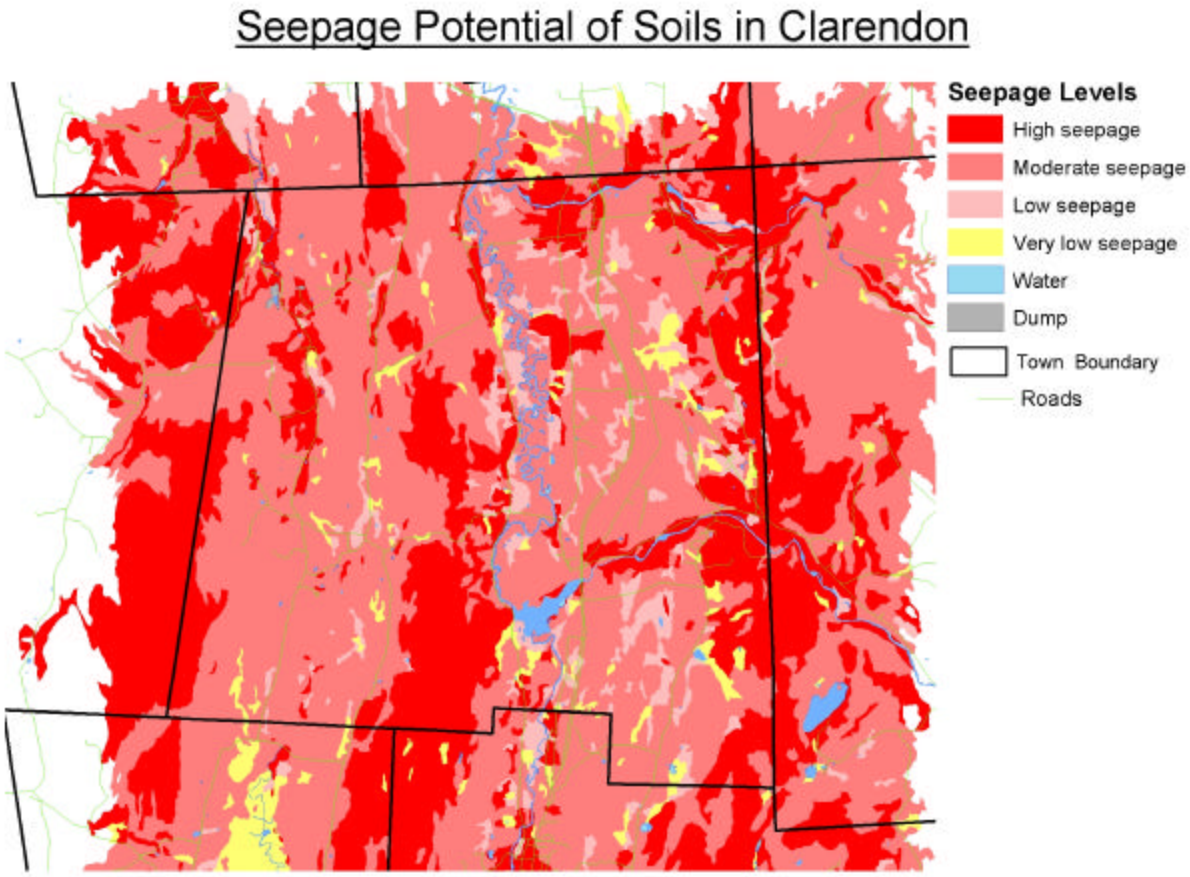


Figure 5: Map showing seepage potential based on the permeability of the soils. The amounts of clay, silt, sand and gravel in the soil play a large role in determining the rate of water movement through the soil. Soils with a majority of clays and silts will prevent water from soaking into the surface and result in higher amounts of surface runoff. Soils with higher amounts of sand and gravel allow water to run through these larger materials and into the groundwater. Soil data was taken from the State Geologic Survey and each soil type was reclassified into four categories (shown on the map below) based on its permeability.

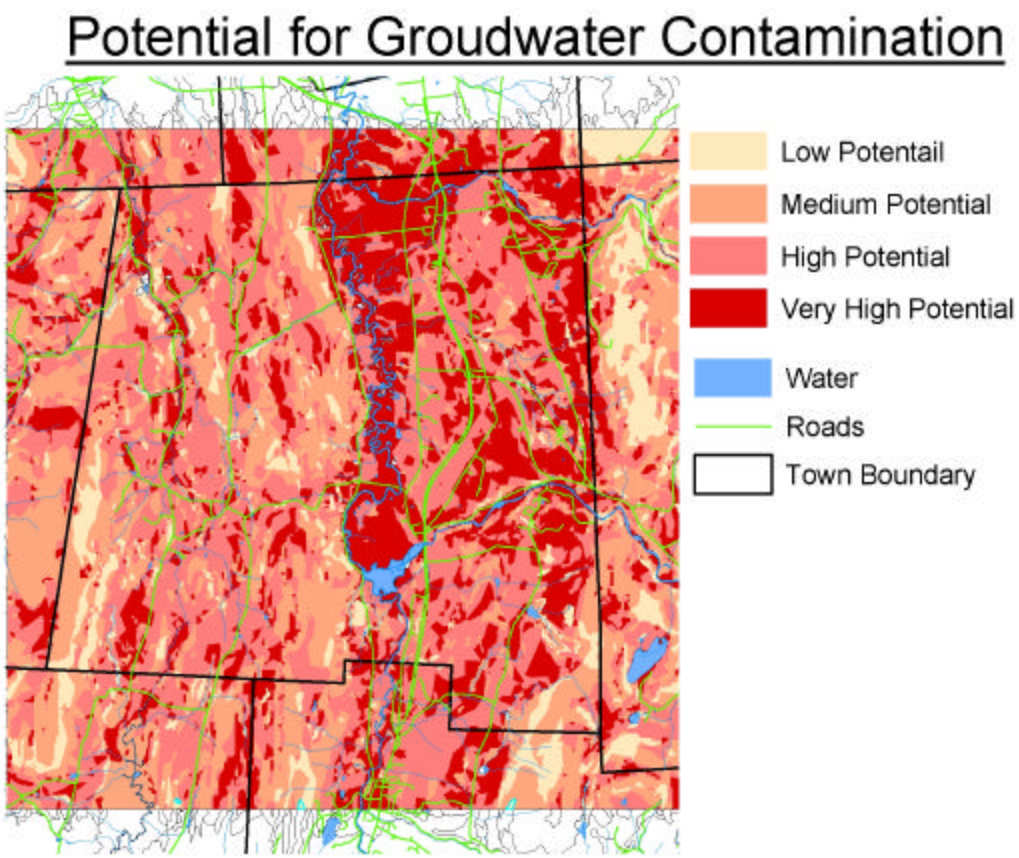


Figure 6: To obtain the *potential groundwater contamination map* areas which had both low slope and high seepage values were highlighted and given a new value representing a high potential for groundwater contamination. Areas with a low slope will allow water to remain on the surface for longer making it easier for the water to soak into the soil and become part of the groundwater system. Areas with high seepage values (sand and gravel soils) will allow water to quickly move through the soil and enter the groundwater. When these two attributes of soil share the same location the potential for groundwater contamination is increased.

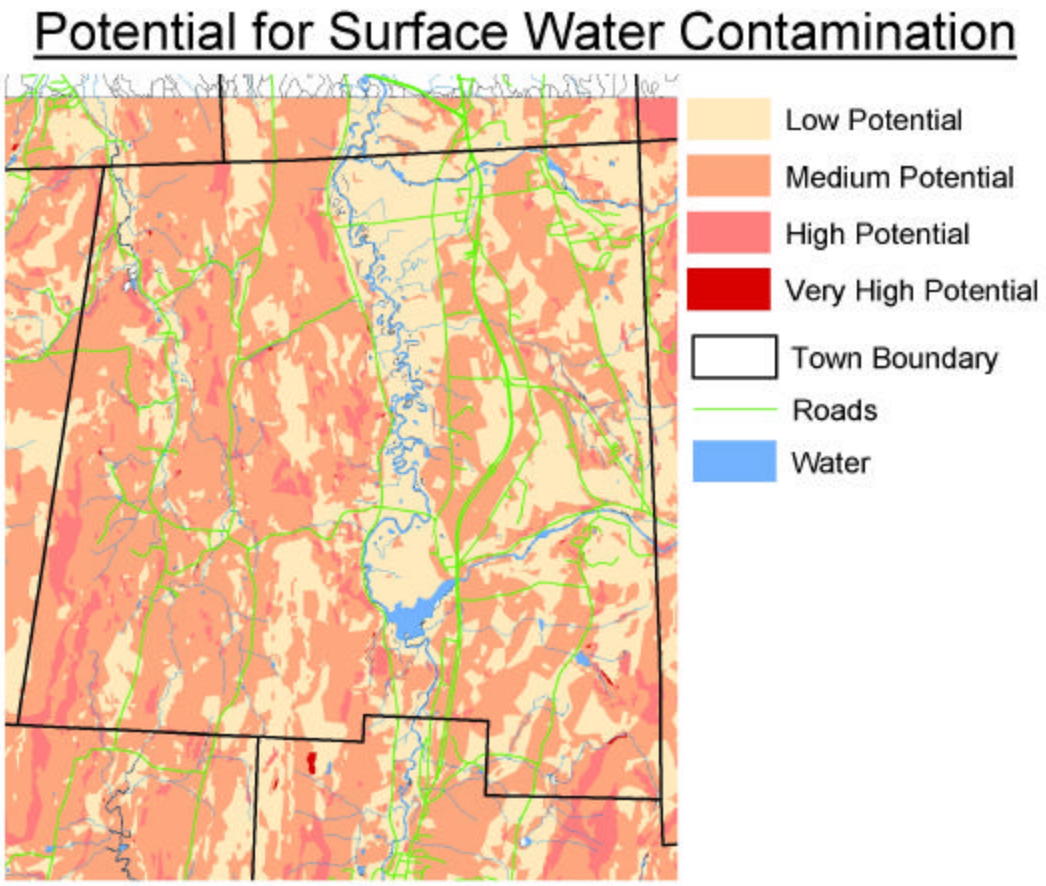
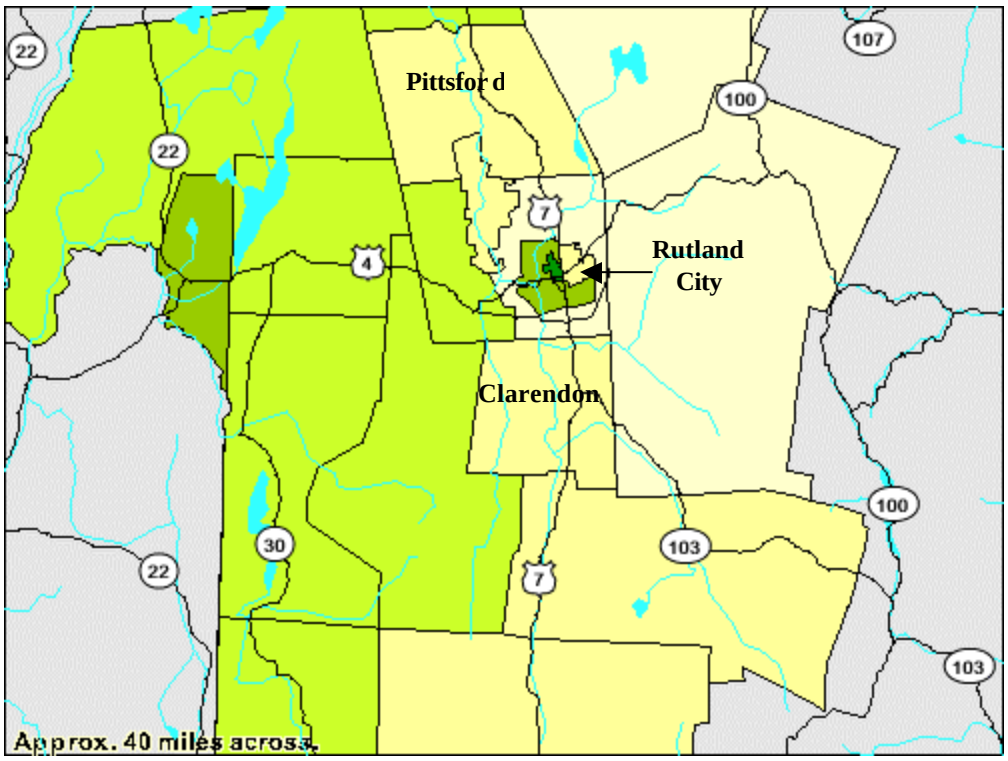


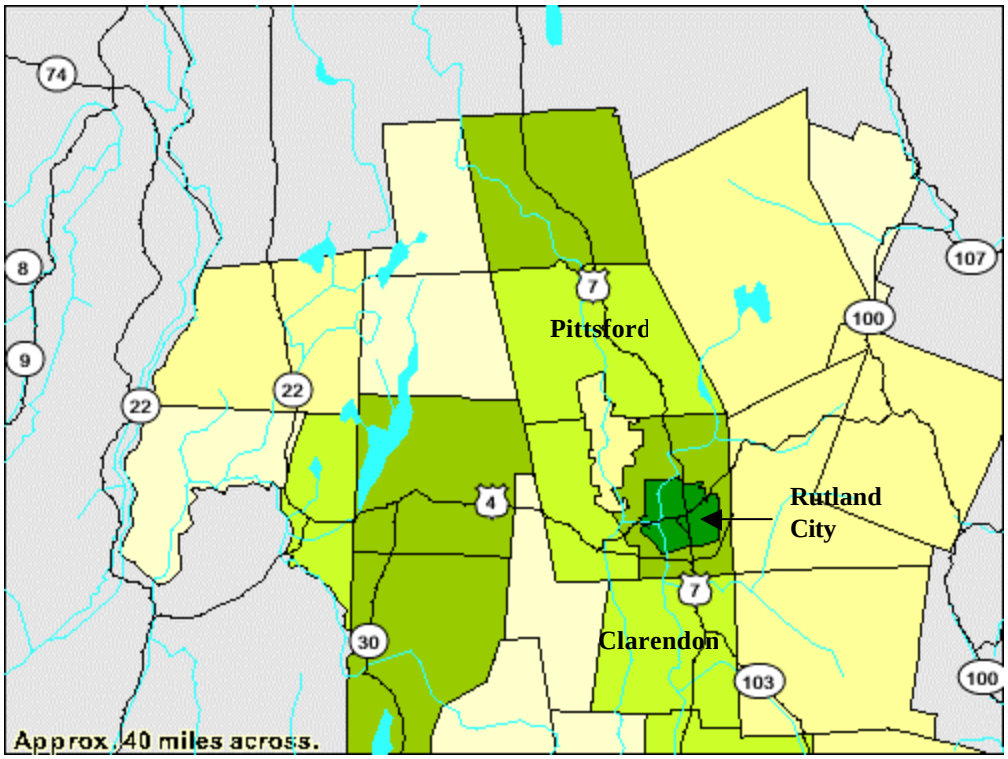
Figure 7: To obtain the *potential surface water contamination map* areas which had both high slope and low seepage values were highlighted and given a new value representing a high potential for surface water contamination. Areas with a high slope will cause water to quickly run off the surface and move down slope into larger bodies of water such as lakes and rivers. Areas with low seepage values (silt and clay soils) will prevent water from moving into the ground and instead will allow it to run off the land and into surrounding waterways. When these two attributes of soil share the same location the potential for surface water contamination is increased.

Figure 8: Percent of Persons Below the Poverty Level in 1999-2000



Source: US Census Bureau, www.census.gov

Figure 9: Total Persons in 2000



Source: US Census Bureau, www.census.gov

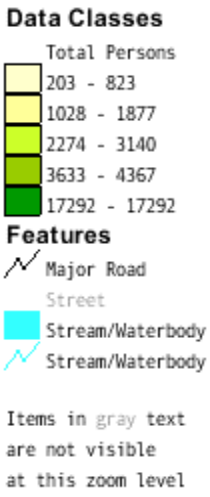
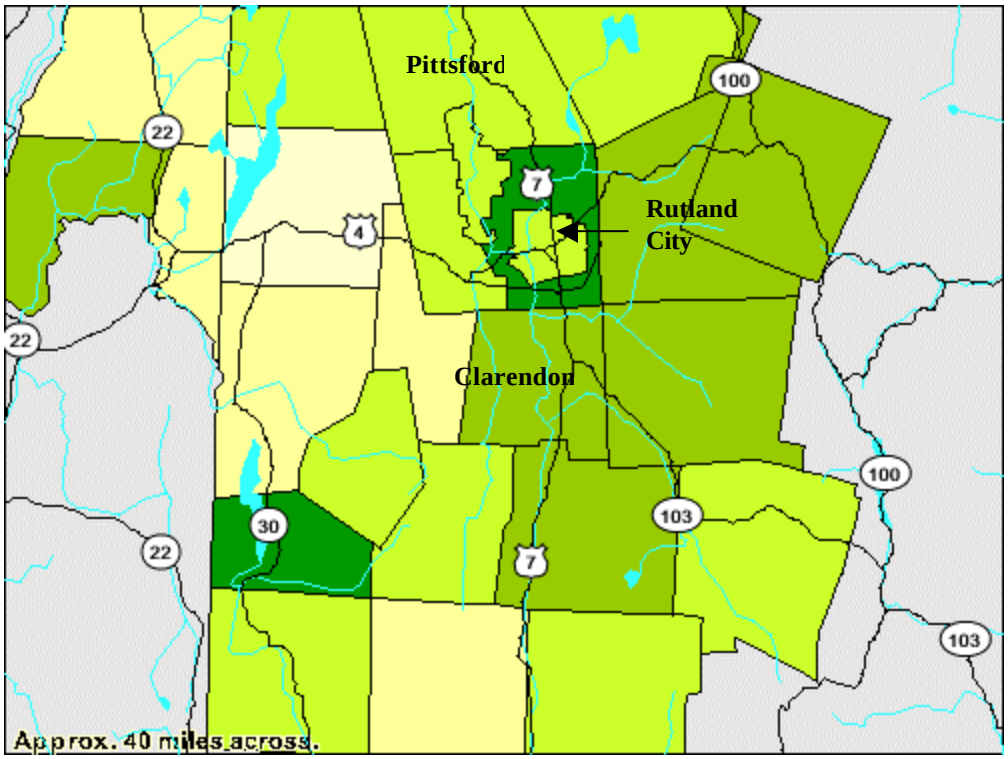
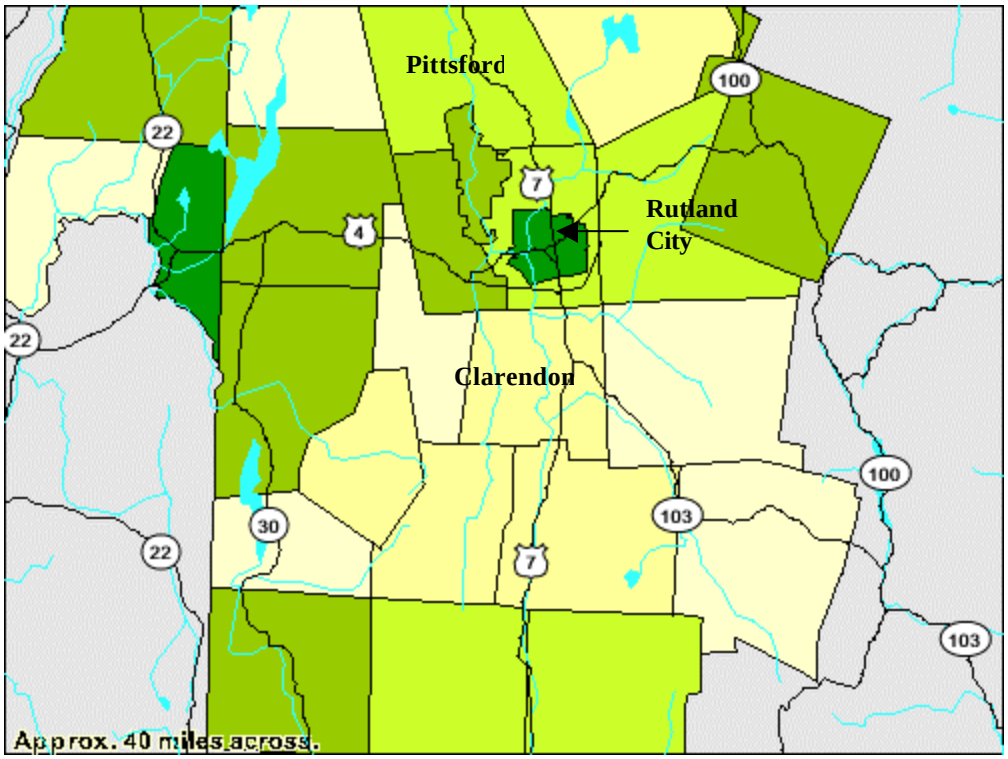


Figure 10: Median Age in 2000



Source: US Census Bureau, www.census.gov

Figure 11: Percent of Occupied Housing Units That Are Renter-Occupied in 2000



Source: US Census Bureau, www.census.gov

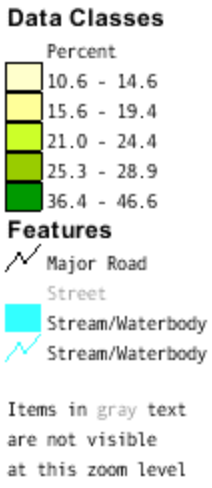
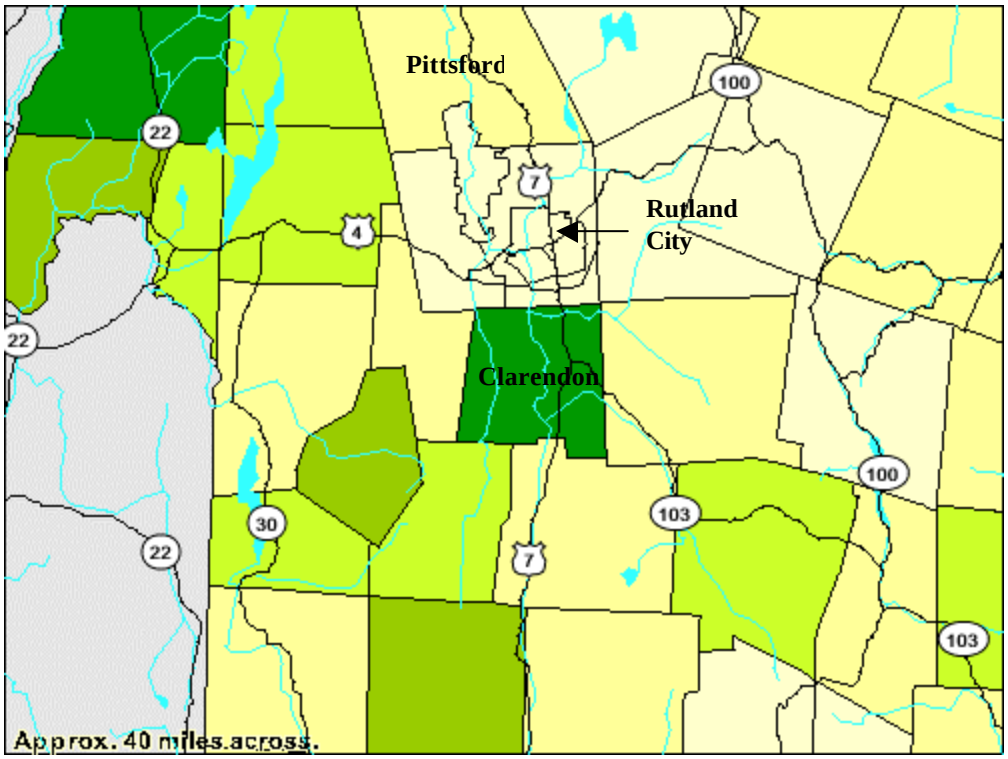
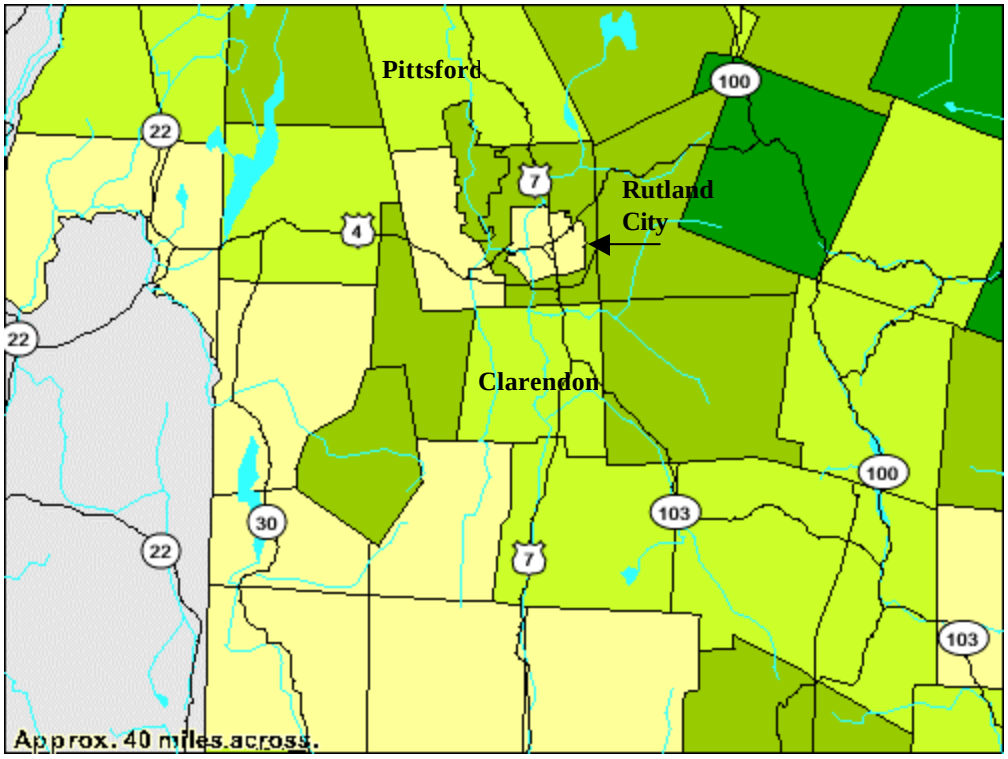


Figure 12: Percent of Housing Units That Are Mobile Homes in 2000



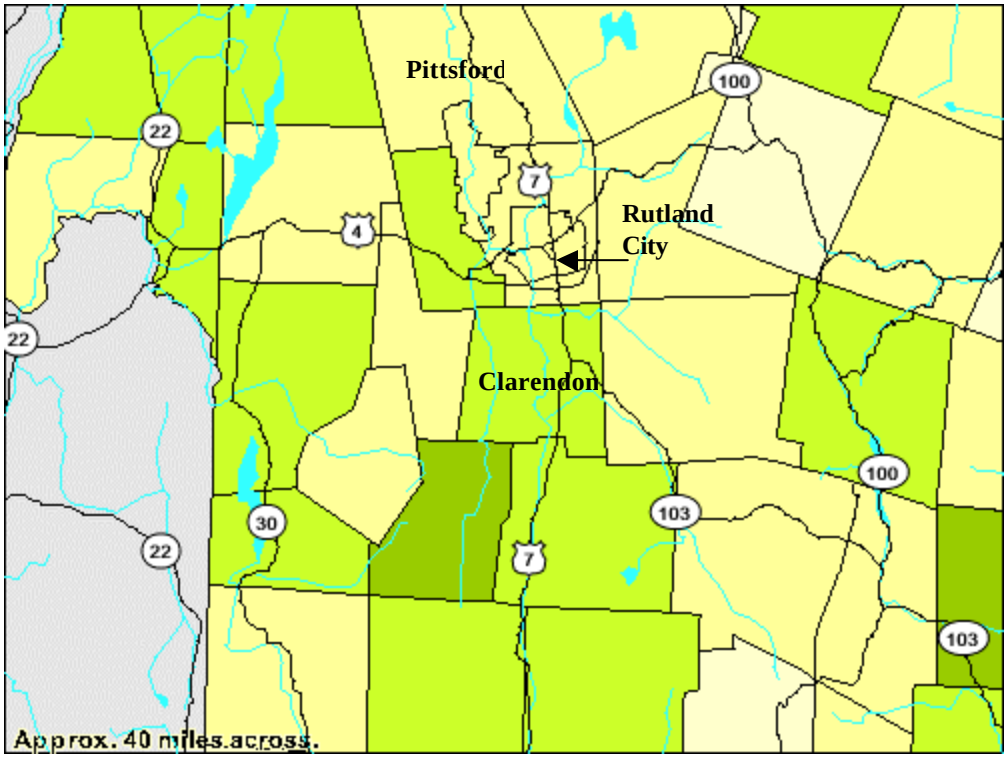
Source: US Census Bureau, www.census.gov

Figure 13: Percent of Persons 25 Years and Over With High School Diploma or More Education in 2000



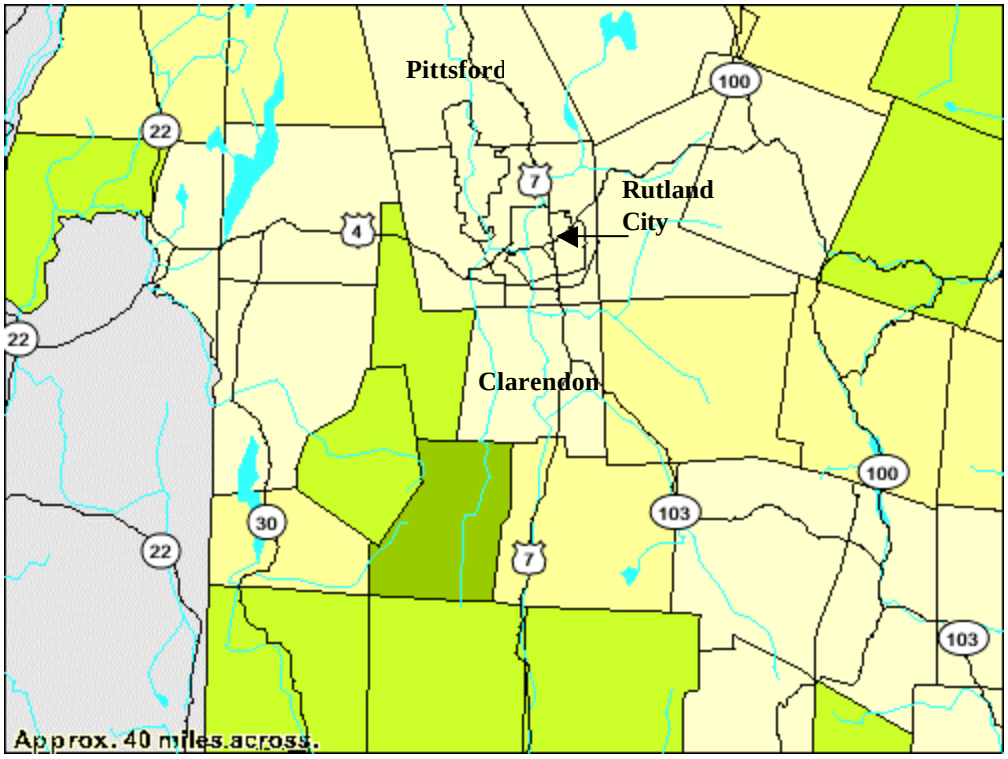
Source: US Census Bureau, www.census.gov

Figure 14: Percent of Employed Civilian Persons 16 Years and Over in Manufacturing Industries in 2000



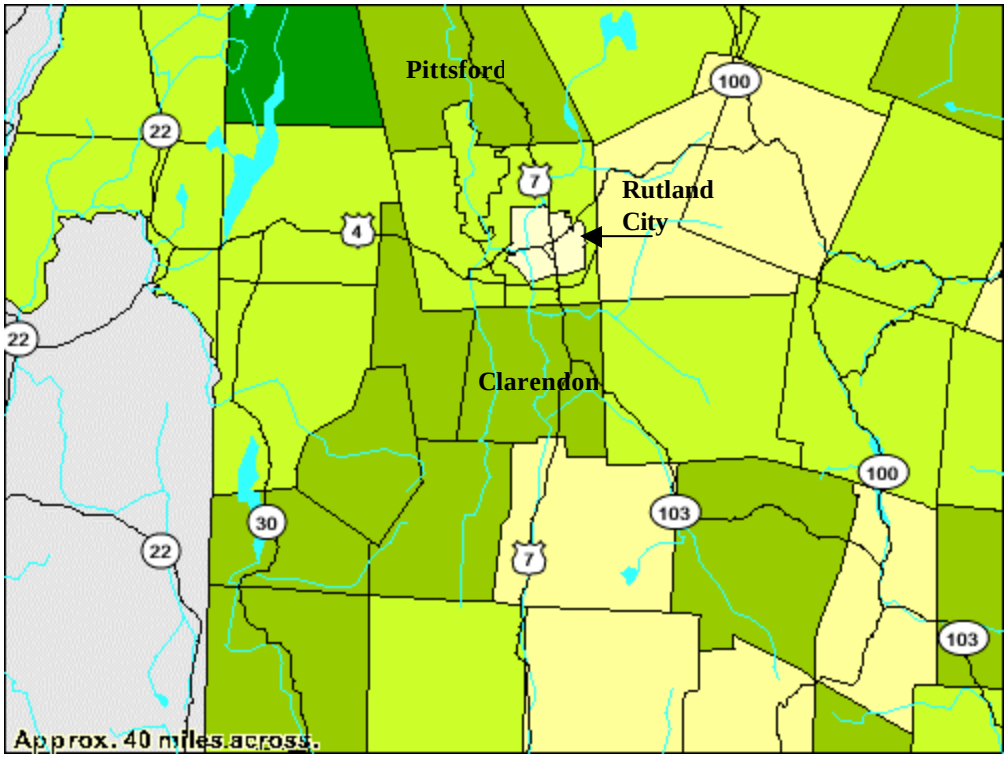
Source: US Census Bureau, www.census.gov

Figure 15: Percent of Employed Civilian Persons 16 Years and Over in Farming, Fishing, and Forestry Occupations in 2000



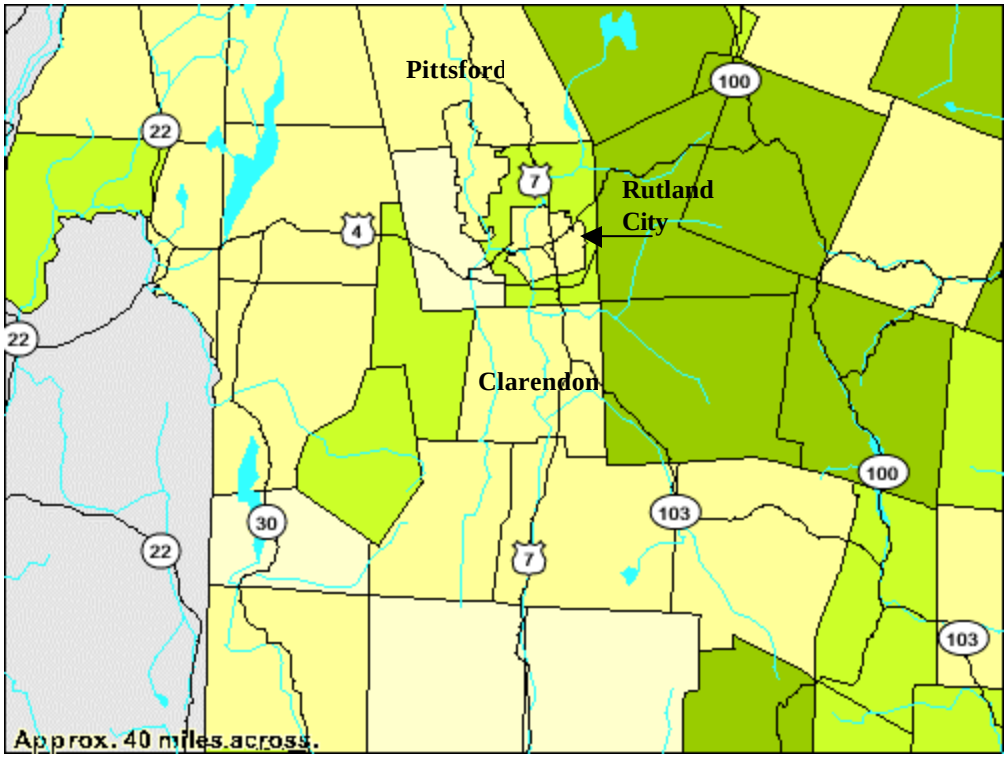
Source: US Census Bureau, www.census.gov

Figure 16: Percent of Employed Civilian Persons 16 Years and Over in Construction, Extraction, and Maintenance Occupations in 2000



Source: US Census Bureau, www.census.gov

Figure 17: Percent of Employed Civilian Persons 16 Years and Over in Management, Professional, and Related Occupations in 2000



Source: US Census Bureau, www.census.gov

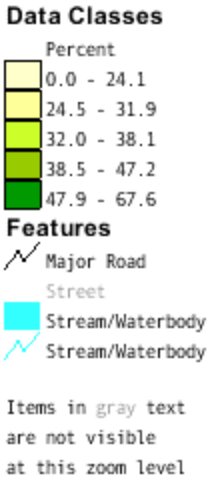
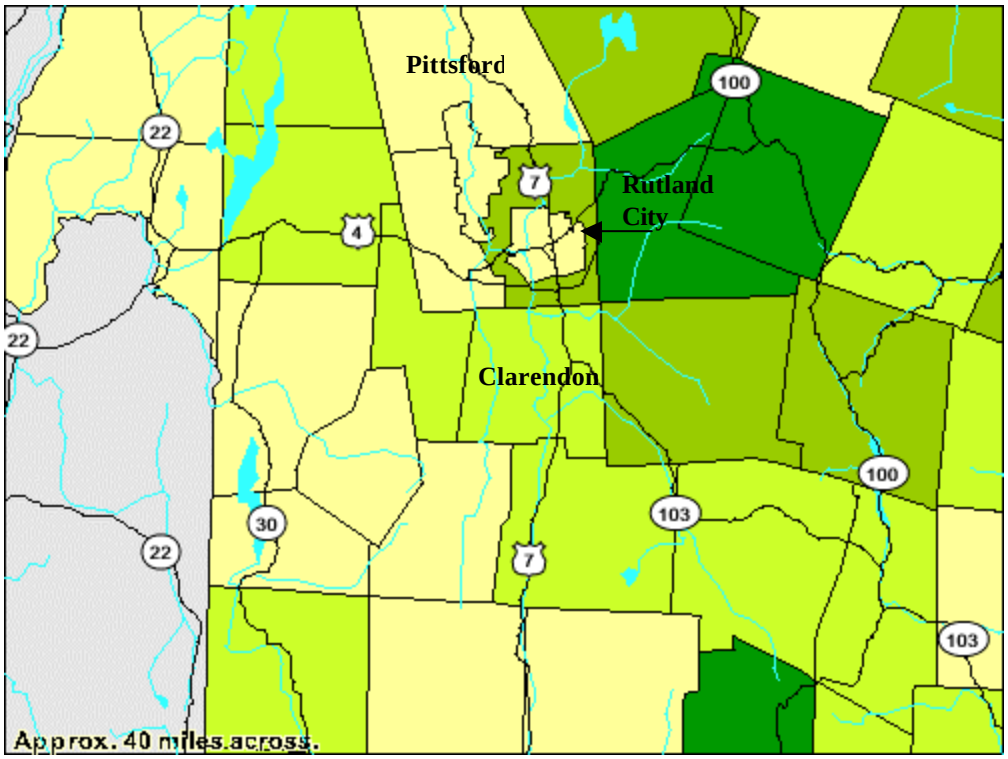


Figure 18: Percent of Households With Income of $100,000 or More in 1999-2000



Source: US Census Bureau, www.census.gov

Appendix 1: Health Questionnaire

ID #

CLARENDON HEALTH QUESTIONNAIRE
ADULT

NAME (Optional):

ADDRESS:

TOWN:

ZIP CODE:

EMAIL (Optional):

This is a health questionnaire that will be part of a study looking at the health of Clarendon residents.. The results will be presented to Clarendon in a public meeting. All residents will be invited to attend.

NO NAMES WILL BE USED. ALL INFORMATION IS CONFIDENTIAL.

Please fill out this health questionnaire to the best of your ability. If you are unable or do not wish to answer a particular question, leave it blank and continue with the rest of the questionnaire. Please use the "Additional Comments" section to list any other information you feel is important for this study, including information regarding deceased family members.

Return promptly to: **T. A.C.**
141 Main Street, Ste 6
Montpelier, VT 05602

T.A.C. is a non-profit that works on public health issues. Information will only be viewed by T.A.C. All individuals assisting in compiling and entering the data from the questionnaire will sign confidentiality agreements.

NO NAMES WILL BE USED. ALL INFORMATION IS CONFIDENTIAL.

SIGNATURE OF PARENT OR GUARDIAN IF UNDER 18:_____

NOTE: This page will be separated from the questionnaire after the data is entered. Only the street address will be linked with the questionnaire results.

Thank you for your cooperation!

ADULT HEALTH QUESTIONAIRE

I. Background Information:

A. Today's Date: _____

B. Your Date of birth: _____

C. Your Place of birth:_____

D. Were you adopted? Yes_____ No_____ Don't Know_____

E. Your racial/ethnic origin: Black_____ White_____ Asian_____ Hispanic_____
American Indian/Native Alaskan_____

F. In what country were your parents born: Father_____ Mother_____

G. What is your current marital status: Single_____ Married_____ Widowed_____
Divorced_____

H. Circle the highest grade completed: 1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 / +

II. **Residence History:**

List below all permanent addresses you have lived at since 1960. By permanent, we mean a place you lived for three months or more. Start with your current address and work back in time.

Street Number	Street Name	City or Town	State	Dates: Mo/Yr to Mo/Yr

III. **Occupational History:**

A. Have you ever been employed outside the home? Yes _____ No _____

B. Have you ever worked for a chemical company or ever worked with chemicals in a job?
Yes _____ No _____ Don't Know _____
If yes: When was that? From_____to_____
What was the name of the company?_____
What did you do there?_____
What chemicals did you work with?_____

C. Have you ever worked with x-rays or other radioactive material? Yes_____ No_____
If yes: When was that? From_____to_____
What was the name of the company?_____
What work did you do there?_____
What type of radiation did you work with?_____

D. At work, have you ever been exposed to lead, mercury, aluminum, arsenic, thallium, gold? Yes_____ No_____ Don't Know_____

E. Have you ever worked with pesticides or fumigants on the job?
Yes_____ No_____ Don't Know_____

F. Are you a Veteran that served in Viet Nam? Yes_____No_____

Please list all jobs you have held for at least three months outside the home. Start with your current or most recent job and go back in time.

Name of Company Or Employer	Type of Company office, steel or paper plant	Date started with the Company and stopped	Job title and specific work description Include materials used

IV. **Smoking History:**

A. Are you presently a cigarette smoker? Yes_____ No_____
If yes: How many cigarettes do you smoke a day? _____Packs
How many years have you smoked? _____ Years

B. If you **do not** smoke now, did you smoke cigarettes in the past? Yes_____ No_____
If yes: How many cigarettes do you smoke a day? _____Packs
How many years have you smoked? _____ Years

C. Do you currently smoke a pipe? Yes_____ No_____
If yes: How many pipes full do you smoke? _____Per Day
How many years have you smoked a pipe? _____Years

D. If you **do not** smoke a pipe now, did you smoke a pipe in the past? Yes_____ No_____
If yes: How many pipes full do you smoke? _____Per Day
How many years have you smoked a pipe? _____Years

E. Do you currently smoke cigars? Yes_____ No_____
If yes: How many cigars do you smoke a day? _____
How many years have you smoked cigars? _____ Years

F. If you **do not** smoke cigars now, did you smoke cigars in the past? Yes_____ No_____
If yes: How many cigars do you smoke a day? _____Packs
How many years have you smoked cigars? _____ Years

V. **Alcohol History**:

A. About how often do you drink some kind of alcoholic beverage?

Three or more times a day_____ Once or twice a week_____
Twice a day_____ Once or twice a month_____
Every day or almost every day_____ Less than once a month(includes special occasional drinking)_____
Five or six times a week_____
Three to four times a week_____ Never_____

B. When you drink, how many bottles of beer, glasses of wine, cocktails or mixed drinks do you usually drink in one sitting?

12 or more drinks_____ 4 drinks_____
9 to 11 drinks_____ 3 drinks_____
7 to 8 drinks_____ 2 drinks_____
5 to 6 drinks_____ 1 drink_____

VI. Family History:

Has your mother, father, brother, or sister ever had any of the following health problems? Check the appropriate box for each one.

Ever had this problem?	No	Yes	Don't Know	Mother	Father	Brother	Sister
1. Allergies or asthma							
2. Anemia							
3. Cancer or tumor							
4. Alcohol or drug problem							
5. Diabetes/sugar							
6. Epilepsy/seizures							
7. Heart trouble							
8. Kidney or bladder trouble							
9. Liver disease							
Ever had this problem?	**No**	**Yes**	**Don't Know**	**Mother**	**Father**	**Brother**	**Sister**
10. High blood pressure							
11. Mental/Emotional problems							
12. Rheumatism/arthritis							
13. Stomach/Ulcer							
14. Tuberculosis							
15. Weight problems/obesity							
16. Infertility							
17. Chronic bronchitis/emphysema							
18. Birth Defects							

If yes to any question above please specify:
_____
_____
_____
_____
_____

VII. **Personal Health:**

A. At present, are you going to a doctor for any health problem(s)? Yes_____ No_____
If yes: What is the problem(s)?_____
_____
_____
_____

B. Have you been sick in the past month? Yes_____ No_____
If yes, please specify the type of illness :
_____
_____

C. Can you remember having had any of the following problems over the past 12 months, at home or at work?

	Yes	No	Don't Know
1. Eye Irritation			
2. Ear Infection			
3. Nasal Irritations			
4. Nose Bleeds			
5. Sore Throats			
6. Any other problems with your eyes, ears, nose, or throat? If yes: Please specify:			
7. Cough			
8. Wheezing			
9. Tightness in the chest			
10. Frequent Colds			
11. Any other problems with your lungs? If yes, please specify:			
12. Chest Pain			
13. Swelling in the legs			
14. Any other problems with your chest or heart? If yes, please specify:			
15. Loss of 10 lbs. of weight without dieting			
16. Loss of Appetite			
17. Nausea			
18. Vomiting			
19. Abdominal pain			
20. Diarrhea			
21. Constipation			
22. Any other problems with your stomach or abdomen? If yes, please specify:			
23. Dark brown urine			
	Yes	No	Don't Know
24. Red Urine			
25. Burning on urination			
26. Difficulty in controlling urination			
27. Difficulty starting to urinate			
28. Difficulties with wetting			
29. Any other urinary problems? If yes, please specify:			
30. Headaches			

31. Dizziness			
32. Blurred Vision			
33. Do you wear glasses			
34. Have you had a change of eyeglasses			
35. Loss of balance/ clumsiness			
36. Muscle weakness			
37. Fatigue			
38. Numbness in extremities (fingers, toes, etc..)			
39. Nervousness			
40. Loss of Consciousness			
41. Poor Memory			
42. Seizures			
43. Convulsions			
44. Epilepsy			
45. Has a physician ever told you that you have any other problem like those mentioned? If yes, please specify:			
46. Joint pain			
47. Swelling in joints			
48. Any other problems with your bones or joints? If yes, please specify:			
49. Rash			
50. Acne			
51. Slow healing of cuts			
52. Change in nail growth			
53. Any other skin problems? If yes, please specify:			
54. Dry skin			
55. Excessive perspiration			
56. Swollen lymph nodes			
57. Menstrual irregularity			
58. Is there anything else that hasn't been covered? If yes, please specify:			

D. Have you ever been told by a physician that you had any of the following conditions and in what year were you told you had this condition?

	Yes	No	Year / How many times
59. High Blood Pressure			
60. Blood Disorder			
61. Heart Murmur			
62. Heart Attack			

63. Heart Disease			
64. Rapid Pulse			
65. Easy Bruising			
66. Emphysema			
67. Chronic bronchitis			
68. Tuberculosis			
69. Hepatitis			
70. Peptic Ulcer disease			
	Yes	No	Year / How many times
71. Pancreatitis			
72. Anemia			
73. ITP			
74. Thyroid Disease			
75. Diabetes			
76. Stroke			
77. Phlebitis			
78. Hay Fever To what:			
79. Allergies To what:			
80. Asthma			
81. Kidney Disease			
82. Kidney stone(s)			
83. Leukemia			
84. Lymphoma			
85. Liver disease			
86. Cancer What type:			
87. Gallstones			
88. Ulcerated colitis			
89. Diverticulitis			
90. Gout			
91. Dermatitis, recurrent skin problems, or eczema/psoriasis			
92. Arthritis			
93. Osteoarthritis (old age arthritis			
94. Rheumatoid Arthritis			
95. Lupus erythematosus			
96. Kidney or bladder infection(s)			
97. Pneumonia			
98. Trouble with your immune system (your body's defenses)			
99. Recurrent Infections			
100. Nervous Breakdown			

Do any of the above health problems ever change when you leave your home for a length of time, such as vacations? Yes_____ No_____
If yes, please explain:_____

VIII. **Hospitilization:**

A. Have you ever been hospitilized for any reason? Yes_____ No_____

B. Have you ever been hospitalized to have an operation? Yes_____ No_____

Nature of Operation	Month / Year	Location and name of hospital	Name of Doctor

C. Have you ever been hospitalized for medical reasons **not** requiring surgery? Yes_____ No_____

Medical Reason	Month / Year	Location and name of hospital	Name of Doctor

IX. **Medications and X-rays**

A. In the past one year have you taken any of the following kinds of medications or drugs?

	Yes	No
1. Tranquilizers		
2. Medications for depressions		
3. Medications for tuberculosis		
4. Medications for seizures		
5. Medications for high blood pressure		
6. Medications for gout		

B. Please list the names of any medications you checked above plus any other medications you have taken in the past one year that were prescribed by a physician:

Name of Medication	Month started	Month Stopped

MEN ONLY

X. **Men's Reproductive History:**

A. Have you ever fathered a child (whether or not the child was born?
Yes_____ No_____

B. Do you now have, or have you ever had a fertility problem? Yes_____
No_____

C. If yes: Are you aware of any reason(s) for the infertility? Yes_____
No_____
What were the reasons
given?_____

Community Health Survey

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